Lahore University of Management Sciences

CS 5602 – Game Design and Development

Fall 2024

Subject to Change

To understand how to navigate course outlines, consult: How to Use a Course Outline (http://surl.li/gpvuw)

Instructor	Salman Arif
Room No.	
Office Hours	By appointment
Email	salman@studio67.io
Telephone	0312-4246666
Secretary/TA	
TA Office Hours	
Course URL (if any)	
Support Services	LUMS offers a range of academic and other services to support students. These are mentioned below, and you are encouraged to use these in addition to in-class assistance from course staff. For a complete list of campus support services available for you click here (https://advising.lums.edu.pk/#supportservices)

Course Basics				
Credit Hours	3			
Lecture(s)	Nbr of Lec(s) Per Week	2	Duration	75 minutes
Recitation/Lab (per week)	Nbr of Lec(s) Per Week		Duration	
Tutorial (per week)	Nbr of Lec(s) Per Week		Duration	

Course Distribution	
Core	No
Elective	Yes
Open for Student Category	All
Close for Student Category	None

COURSE DESCRIPTION
This course will introduce students to fundamental principles of game design and development. The course will conclude with a team-based project that will require students to design and implement a game of their choice using C# in the Unity game engine; students will form their own teams of 3 members each. Some Unity concepts will be explained in class, but students will be required to learn the engine outside class hours.

COURSE PREREQUISITE(S)	
•	(MATH 120 (Linear Algebra with Differential Equations) OR
•	MATH 121) AND
•	CS 200 (Introduction to Programming)

COURSE OBJECTIVES	
•	To teach students fundamental game design and development principles.
•	Apply theoretical knowledge to the development of a playable game.

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Course Learning Outcomes (CLOs)

CLO	CLO Statement	PLO
CLO 1	Understand the fundamental principles of game design and development such as graphic rendering pipelines, path search, decision making, game rules and mechanics, game loop and progression design.	PLO 2 Knowledge for Solving Computing Problems
CLO 2	Recognize the importance of the game design document and its role in the development process and prepare a detailed game design document.	PLO 7 Communication
CLO 3	Design and develop a compelling game world, characters, and levels while balancing the internal game economy effectively.	PLO 4 Design/ Development of Solutions
CLO 4	Analyze game design to incorporate camera projections, creating art assets and polishing game elements such as visual effects (VFX) and sound effects (SFX).	PLO 3 Problem Analysis
CLO 5	Collaborate to develop game in groups.	PLO 6 Individual and Teamwork
CLO 6	Use modern tools and techniques for developing games and applying essential math concepts such as dot and cross products, quaternion rotations, collision detection, and ray casting.	PLO 5 Modern Tool Usage

Grading Breakup and Policy

Quizzes:	40% (in class, announced)	CLO1
Unity game engine C# assignments:	10%	CLO6
Project:	50%	
1. Requirements Document:		
a. Game concept overview document:	5%	CLO2
2. Design Document and task breakdown:		
a. Draft game design document:	5%	CLO3
b. Full game design document:	10%	CLO4
3. Game Prototype and task breakdown:		
a. Game prototype 1:	5%	CLO6
b. Game prototype 2:	10%	CLO6
4. Final Game and task breakdown:		
a. Final game demo:	15%	CLO6

Below, we describe how each type of assessment will be conducted:

Quizzes: Quizzes will be announced, will take place during class timings, and will include topics covered in the course until the day of the quiz. All quizzes will count towards the final grade, i.e., this course does not have an n-1 policy.

Unity game engine C# assignments: Assignments will be completed individually to get familiar with the engine and language.

Game concept overview document: This is a 2-3 page document, the contents of which will be explained in class. The document will be graded based on clarity of exposition of the proposed project game. The genre and high-level concept will be locked at the time of this document's submission, to allow time for the game's development.

Draft game design document: This document will contain those portions of game design that will have been studied in class until the day before this document is due. As will be explained in class, it is the role of game designers to fully specify design decisions with numbers, equations, or charts, as appropriate; in this document, it will not be sufficient to describe, for example, a Tower Defense game as having a "tower that buffs nearby towers". The document must clearly specify the distance and buff percentage. Providing general statements will negatively reflect in the assigned grade. As part of this deliverable, teams will submit a Task Division Document; normally, all team members will get assigned the same marks, but if the Task Division Document shows shirking or lop-sided task assignment, team members will have individual marks assigned.

Full game design document and task breakdown: This is the final game design document with all game elements fully described, and is likely to be 70-100 A4-sized pages long, depending on the scope of the game. There must be complete alignment between the final game design document and the final game that is delivered. As will be explained in class, it is the role of game designers to fully specify design decisions with numbers,

equations, or charts, as appropriate; in this document, it will not be sufficient to describe, for example, a Tower Defense game as having a "tower that buffs nearby towers". The document must clearly specify the distance and buff percentage. Providing general statements will negatively reflect in the assigned grade. As part of this deliverable, teams will submit a Task Division Document; normally, all team members will get assigned the same marks, but if the Task Division Document shows shirking or lop-sided task assignment, team members will have individual marks assigned.

Game prototype 1: The prototype must compile without errors. It should accept player control, have the camera working, and the core game loop should have been implemented. It will be a playable game, but with placeholder art and no level transitions, including no main menu screen that transitions to the actual game. Grading will consider quality of code in terms of optimization and defensive coding techniques studied in class in addition to application of good OOP principles, such as class specialization and avoidance of the use of public variables. To prevent plagiarism, the full project folder, including C# code and Unity project file, must be submitted on a USB stick or via an online drive link; failure to provide this will result in no marks being awarded to the team. As part of this deliverable, teams will submit a Task Division Document; normally, all team members will get assigned the same marks, but if the Task Division Document shows shirking or lop-sided task assignment, team members will have individual marks assigned.

Game prototype 2: The prototype must compile without errors. Key art and sound have been implemented; note that due to the limited time available, students are encouraged to use high-quality CC0 license art and sound assets available freely online – some links will be provided in class. There should be meaningful progress from Game Prototype 1: there should be further layering of game loops, and game balance should have been achieved. Grading will consider quality of code in terms of optimization and defensive coding techniques studied in class in addition to application of good OOP principles, such as class specialization and avoidance of the use of public variables. To prevent plagiarism, the full project folder, including C# code and Unity project file, must be submitted on a USB stick or via an online drive link; failure to provide this will result in no marks being awarded to the team. As part of this deliverable, teams will submit a Task Division Document; normally, all team members will get assigned the same marks, but if the Task Division Document shows shirking or lop-sided task assignment, team members will have individual marks assigned.

Final game demo: There must be complete alignment between the final game design document and the final game that is delivered. The final build should compile without errors. There should be meaningful progress from Game Prototype 2: the game should be a polished product with appropriate use of VFX and SFX, it should have an operational user interface, and the menu and game scene transitions should be working. Grading will consider quality of code in terms of optimization and defensive coding techniques studied in class in addition to application of good OOP principles, such as class specialization and avoidance of the use of public variables. To prevent plagiarism, the full project folder, including C# code and Unity project file, must be submitted on a USB stick or via an online drive link; failure to provide this will result in no marks being awarded to the team. As part of this deliverable, teams will submit a Task Division Document; normally, all team members will get assigned the same marks, but if the Task Division Document shows shirking or lop-sided task assignment, team members will have individual marks assigned.

Examination Detail	
Midterm Exam	Yes/No: No Combine Separate: Duration: Preferred Date: Exam Specifications:
Final Exam	Yes/No: No Combine Separate: Duration: Exam Specifications:

Campus supports & Key university policies

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Campus Supports

Students are strongly encouraged to meet course instructors and TA's during office hours for assistance in course-content, understand the course's expectations from enrolled students, etc. Beyond the course, students are also encouraged to use a variety of other resources. (Instructors are also encouraged to refer students to these resources when needed.) These resources include Counseling and Psychological Services/CAPS (for mental health), LUMS Medical Center/LMC (for physical health), Office of Accessibility & Inclusion/ OAI (for long-term disabilities), advising staff dedicated to supporting and guiding students in each school, online resources (https://advising.lums.edu.pk/advising-resources), etc. To view all support services, their specific role as well as contact information click here (https://advising.lums.edu.pk/#supportservices).

Academic Honesty/Plagiarism

LUMS has zero tolerance for academic dishonesty. Students are responsible for upholding academic integrity. If unsure, refer to the student handbook and consult with instructors/teaching assistants. To check for plagiarism before essay submission, use similarity@lums.edu.pk. Consult the following resources: 1) Academic and Intellectual Integrity (http://surl.li/gpvwb), and 2) Understanding and Avoiding Plagiarism (http://surl.li/gpvwo).

LUMS Academic Accommodations/ Petitions policy

Long-term medical conditions are accommodated through the Office of Accessibility & Inclusion (OAI). Short-term emergencies that impact studies are either handled by the course instructor or Student Support Services (SSS). For more information, please see Missed Instrument or 'Petition' FAQs for students and faculty (https://rb.gy/8sj1h)

LUMS Sexual Harassment Policy

LUMS and this class are a harassment-free zone. No behavior that makes someone uncomfortable or negatively impacts the class or individual's potential will be tolerated.

To report sexual harassment experienced or observed in class, please contact me. For further support or to file a complaint, contact OAI at oai@lums.edu.pk or harassment@lums.edu.pk. You may choose to file an informal or formal complaint to put an end to the offending behavior. You can also call their Anti-Harassment helpline at 042-35608877 for advice or concerns. *For more information: Harassment, Bullying & Other Interpersonal Misconduct: Presentation (http://surl.li/gpvwt)*

COURSE OVERVIEW			
Week/ Lecture/ Module	Topics	Recommended Readings	Assessments/ Milestones
Introduction			
1	Introduction, game design vs development, industry structure, social issues		
2	Unity essentials 1		
3	Unity essentials 2		
4	Unity optimizations		**Team formation**
Game Design			
5	Game design document, ideation, story and narrative		
6	World and level design		**Game concept overview document**
7	Combat mechanisms		**Quiz 1**
8	Player and enemy character design		
9	Camera projection and perspective, control		
10	Gameplay challenges and actions, game loops		**Draft game design document**
11	Core mechanics, progression and emergence		
12	Game economy, game balance, feedback loops		
Game Math & Graphics			
13	3D models and textures, rigging and animation, user interface		**Quiz 2**
14	Vectors, matrices, transforms		**Final game design document**

15	Polar coordinates, rotations, quaternions, curves, splines		
16	Coordinate spaces, lighting, graphics render pipeline, shaders		
17	Rays, planes, collisions, projectiles, springs		**Game prototype 1**
Game Development			
18	Kinematic and dynamic movements		
19	Graphs, Dijkstra pathfinding, A* pathfinding, heuristics, navigation meshes		
20	Decision tree, FSM, behavior tree, goal-oriented behavior, goal-oriented action planning		**Quiz 3**
21	Influence map, coordinated behavior, game tree		**Game prototype 2**
22	Perlin noise, binary space partitioning, cellular automata		
23	Diamond square, maze generation		
24	Game demos		**Final game demo**
25	Game demos		**Final game demo**
26	Game demos		**Final game demo**
27	Buffer		
28	Buffer		**Quiz 4**

Textbook(s)/Supplementary Readings
Reference Texts (Optional): Fundamentals of Game Design, 3rd Edition, Ernest Adams Game Mechanics – Advanced Game Design, Ernest Adams and Joris Dormans 3D Math Primer for Graphics and Game Development, 2nd Edition, Fletcher Dunn and Ian Parberry Fundamentals of Computer Graphics, 5th Edition, Steve Marschner and Peter Shirley Real-time rendering, 4th Edition, Tomas Akenine-Moller et al Real-time Collision Detection, 1st Edition, Christer Ericson AI for Games, 3rd Edition, Ian Millington Game Engine Architecture, 3rd Edition, Jason Gregory

HARASSMENT POLICY

- SSE, LUMS and particularly this class, is a harassment free zone. There is absolutely zero tolerance for any behaviour that is intended or has the expected result of making anyone uncomfortable and negatively impacts the class environment, or any individual's ability to work to the best of their potential.
- In case a differently abled student requires accommodations for fully participating in the course, students are advised to contact the instructor so that they can be facilitated accordingly.
- If you think that you may be a victim of harassment, or if you have observed any harassment occurring in the purview of this class, please reach out and speak to me. If you are a victim, I strongly encourage you to reach out to the Office of Accessibility and Inclusion at oai@lums.edu.pk or the sexual harassment inquiry committee at shic@lums.edu.pk for any queries, clarifications, or advice. You may choose to file an informal or a formal complaint to put an end of offending behaviour. You can find more details regarding the LUMS sexual harassment policy here.
- To file a complaint, please write to harassment@lums.edu.pk.

SSE COUNCIL ON EQUITY AND BELONGING

- In addition to LUMS resources, SSE's Council on Belonging and Equity is committed to devising ways to provide a safe, inclusive, and respectful learning environment for students, faculty, and staff. To seek counsel related to any issues, please feel free to approach either a member of the council or email at cbe.sse@lums.edu.pk

Please note that the syllabus is tentative and may be subject to some changes.